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## Development and measurement properties of the self assessment version of the INTERMED for the elderly to assess case complexity

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### ABSTRACT

**Objectives:** The INTERMED for the Elderly Self Assessment (IM-E-SA) was developed to support health care professionals in providing demand driven elderly care. It assesses case complexity and health care needs as perceived by older adults themselves. By applying this instrument tailored care can be provided as it supports professionals in their allocation decisions. The aim was to evaluate the measurement properties of the IM-E-SA.

**Methods:** In this cross-sectional study 338 elderly people completed a postal questionnaire and participated in an interview. Feasibility of the IM-E-SA was assessed by determining the percentages of missing values per item. Reliability of the IM-E-SA was expressed as Cronbach's alpha. Intraclass correlation coefficients (ICCs) were calculated between the IM-E-SA and IM-E. Nonparametric tests were applied to assess if the IM-E-SA could distinguish between subgroups of elderly adults who differed on demographic characteristics and the prevalence of diseases/disorders. Convergent validity and discriminant validity were assessed using Spearman rank correlations between the IM-E-SA and IM-E, life satisfaction (Cantril's Ladder of Life), activities of daily living (Katz extended), quality of life (EQ-5D), mental health (SF-36) and prevalence of diseases/disorders.

**Results:** Percentages of missing values per IM-E-SA item ranged from 0 to 5%. Cronbach's alpha was .78. The ICC between the total scores of the IM-E-SA and the IM-E was .68. The IM-E-SA yielded statistically significant differences between subgroups (known-group validity). Correlations evaluating the convergent validity were moderate to strong (.50–.70). Those correlations assessing the discriminant validity were moderate (.38–.53).

**Conclusion:** This study supports the feasibility, reliability and validity of the IM-E-SA.

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### Introduction

Life expectancy is increasing worldwide which contributes considerably to the burden of chronic diseases [1]. Consequently, demands for treatment and care are increasing [2,3]. Especially elderly persons suffer from multiple chronic diseases and are treated by different healthcare professionals. Those professionals may rely on ad hoc assessments and decision-making regarding the planning and content of elderly care. Seemingly, this would appear to yield tailored solutions; however there is also the risk of arbitrary and non-consistent provision of care services. To support professionals in their allocation decisions the INTERMED (IM) was developed several years ago. The purpose of this instrument is to assess case complexity and healthcare needs in order to foster better coordinated and integrated health care [4–6]. The IM is a reliable and valid method for classifying patients' care needs and previous studies also demonstrated its potential to improve patients' care [6–11]. For the use in elderly populations the

IM has been adjusted to the needs and situation of the elderly themselves; the IM for the Elderly [IM-E] [12]. Subsequently, a version to be completed by the elderly themselves (IM for the Elderly Self Assessment [IM-E-SA]) was developed. The latter version was developed to be more time-efficient for professionals and, moreover, to reflect the opinion of the elderly persons themselves about the care received. The IM-E-SA facilitates the development of future demand driven care, though elderly adults with severe cognitive dysfunction or severely illness may not be able to complete the measure. Therefore we excluded these persons from the current study, which presents the first extensive psychometric evaluation to assess the feasibility, reliability and validity of the instrument in a heterogeneous elderly population.

### Methods

#### Participants

From June 2008 until February 2010, a cross-sectional study was conducted among elderly persons from the general population, residing in the Northern provinces of the Netherlands. We recruited 359 elderly people who met the following inclusion criteria: persons 65 years of age and over who were able to fill out questionnaires.

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Elderly people who had severe cognitive dysfunction and/or were very ill were excluded. The research nurses with professional experience in geriatric care assessed if candidate participants had to be excluded because of severe cognitive dysfunction or because they were too ill. They contacted eligible elderly people who lived independently, in assisted-living residences, nursing homes, or homes for the elderly. Participants were identified with help of a geriatric department of a general hospital, home care organisations and associations for the elderly. After consent was obtained, all participants received a postal questionnaire comprising items about demographics, diseases and disorders, and instruments to assess case complexity (IM-E-SA), frailty (Groningen Frailty Indicator [GFI]) and life satisfaction (Cantril's Ladder of Life) [13,14]. After two weeks, the research nurses collected the questionnaire at the elderly homes. They asked the participants to indicate IM-E-SA items which were difficult to fill out and helped the participants to complete them by recording the opinion of the participants themselves. During a semi-structured interview the research nurses completed the IM-E. Subsequently, measurements of activities of daily living (Katz extended), quality of life (EuroQol-5D), and psychosocial functioning (SF-36 mental health subscale) were assessed [15–17]. If needed the research nurse assisted the elderly people with filling out these instruments.

This type of non-intrusive observational study does not require ethical committee approval under Dutch legislation. The participants gave their written informed consent based on a patient's information letter that accompanied the questionnaire. The letter and informed consent form were formulated according to the guidelines of good clinical practice.

### Assessments

In the postal questionnaire we collected data on demographics (age, gender, marital status and living situation) and the presence of 17 diseases (e.g. cancer, cardiovascular disease, and diabetes mellitus). Afterwards the following subgroups were made; 0–1 disease/disorder, 2 diseases/disorders,  $\geq 3$  diseases/disorders.

The original INTERMED is a valid and reliable measure of case complexity and it assesses the healthcare needs in the following domains; biological, psychological, social and healthcare [6,7]. All domains comprise five questions and each domain is assessed in a context of time (history, current state, and prognosis). In total, the instrument consists of 20 4-point rating scale items (range 0–3; higher scores indicating higher levels of complexity) which are summed to calculate the total score (range 0–60). In previous studies the cut-off point of 20/21 of the total IM-score was used: total scores of 21 or higher indicated that participants had complex biopsychosocial health care needs [11,18]. Experts of the INTERMED foundation group ([www.intermedfoundation.org](http://www.intermedfoundation.org)) and associated partners adapted the INTERMED into a version for elderly persons; the INTERMED for the Elderly (IM-E) [12]. This version of the IM was adjusted into the healthcare needs and individual situations of the elderly and as a consequence some items and responding anchor points for scoring of the IM were adjusted. The IM-E proved to be a reliable integrative measure to assess health care needs in epidemiological and clinical settings [12]. Since the IM-E is based on a semi-structured interview which is time consuming for health care professionals, we developed a self assessment version of the IM-E: the IM-E-SA. The items of the IM-E were rephrased to improve its clarity. For example, we modified the IM-E item “Are you a person who generally speaking follows a doctor's directions and advice relevant to your lifestyle? (Resistance to treatment [2c])” into “Do you think it is difficult to follow your health caregivers' recommendations [i.e. diet, physical activity, life style, medication intake]? (Resistance to treatment [2c]).” In addition the following changes were made: the item ‘chronicity (1a)’ of the biological domain was changed from one item into two items to differentiate between (the durations of) physical dysfunction and the occurrence of chronic diseases. The scores on both items are recoded back to one item. Finally, in the health care domain the focus of the item ‘complexity of care (4c)’ was changed

from assessing the number of healthcare professionals involved (both from somatic and mental health care) to an evaluation of the collaboration between several healthcare professionals. The full version of the IM-E-SA is available as web-appendix to this paper.

Frailty was assessed with the internally consistent and valid GFI [13,19–21]. It comprises 15 items and measures the loss of functions and resources in four domains: physical, cognitive, social, and psychological [19]. All answer categories were dichotomised and a score of 1 indicates a problem or dependency on that specific item. The range of the GFI total score is 0–15 [19].

Life Satisfaction was assessed using the validated Cantril's Ladder of Life scale – present life satisfaction [14,22,23]. Ratings are made on a 10-point scale that ranges from worst possible life to best possible life with higher scores indicating better life satisfaction.

The Katz Extended Instrumental Activities of Daily Living (Katz extended) measures independency in personal and instrumental activities of daily living. It includes six ADL items and four instrumental-ADL items and each item is scored with a 0 (dependent) or 1 (independent), range 0–10 [15,24].

The EuroQol-5D (EQ-5D) is a reliable and valid tool for measuring health-related quality of life. The instrument comprises five domains: mobility, self-care, pain, usual activities, and psychological status (answers-categories: no/some/severe problems). An index score was calculated for each participant's health status [16].

The SF-36 is a generic health questionnaire. For this study, we assessed the mental health subscale, which contains five items. Scores on the scale ranged from 0 to 100 with a score of 100 indicating the highest rating of mental health [17].

### Statistics

Baseline characteristics were analysed using descriptive statistics. Differences between the study sample and excluded participants were evaluated with the *t*-test for independent groups or Pearson's chi-square tests. Feasibility was assessed by the percentages of missing values per item. Arbitrarily we decided that a total IM-E-SA score was calculated if at least seventeen of the twenty items (85%) were filled out. To calculate total scores, missing values were replaced by the mean score of the items completed by the participant.

The reliability of the IM-E-SA was analysed by calculating the Cronbach's alpha, where an alpha above .70 indicates satisfactory internal consistency of a scale [25]. Regarding domain scores and total scores the interrater agreement (IM-E-SA versus IM-E) was calculated with intraclass correlation coefficients (ICCs). The ICC calculations that were performed used the two way mixed models for absolute agreement. Intraclass correlation coefficients can be interpreted as follows: 1.0 is perfect agreement; .99 to .81 almost perfect agreement; .80 to .61 substantial agreement; .60 to .41 moderate agreement; .40 to .21 fair agreement; .20 to .01 slight agreement; .0 to –.1 poor agreement [26]. We hypothesised substantial to moderate agreement between the IM-E-SA and IM-E as both instruments assess case complexity from different perspectives. The construct validity of the IM-E-SA was assessed in terms of known-group validity, convergent validity, and discriminant validity [27]. Known-group validity was defined as the ability of the IM-E-SA total score to distinguish between subgroups of elderly persons who differ on demographic variables and prevalence of diseases/disorders. We hypothesised that, in contrast with home-dwelling older people and those with none or one disease/disorder, statistically higher IM-E-SA total scores would be found in older adults who live institutionalised or have two or more diseases/disorders. The statistical differences between elderly subgroups were assessed with Mann–Whitney and Kruskal–Wallis tests since the data were not normally distributed [27]. Spearman rank correlations were calculated to assess the convergent and discriminant validity. We assumed moderate to strong correlations (convergent validity) between the IM-E-SA versus IM-E, frailty (GFI) and prevalence of diseases as these are related

concepts. Moderate to strong correlations were also expected between the IM-E-SA physical domain versus activities of daily living, and the IM-E-SA psychological domain versus mental health. We assumed weak to moderate correlations with IM-E-SA scores versus different constructs like quality of life and life satisfaction (discriminant validity) [27]. The standard interpretations of the correlation coefficients were applied; .00–.29 was considered weak; .30–.69 moderate; and .70–1.00 strong [25].

Post-hoc analyses were performed to assess the above-mentioned psychometric properties of the IM-E-SA in specific subgroups (i.e. [1] older adults with mild cognitive dysfunction and [2] participants who did not complete the Katz extended, EQ-5D and SF-36 mental health subscale) and by using other cut-offs for the number of missing values on the IM-E-SA to calculate the total IM-E-SA score (range completed items 15–19 of the total of 20 items). Finally, we performed post-hoc univariate and multivariate linear regression analyses to assess whether demographic characteristics and/or measurement scores were associated with the differences between the IM-E-SA and IM-E total scores. The dependent variable was the delta between the IM-E-SA and IM-E total scores.

All statistical analyses were performed by using SPSS/PASW 18. The level of significance was set at  $P = .05$ .

## Results

### Population characteristics

A total of 359 elderly persons consented to participate in the study, completed the postal questionnaire and participated in the home interviews for the assessment of case complexity (IM-E). In total 338 elderly persons met the inclusion criteria since they completed at least 17 items of the IM-E-SA. The research nurses, with professional experience in geriatric care, did not encounter participants who had to be excluded because of severe cognitive dysfunction. The 21 older adults who were excluded did not differ from those who were included, with regard to gender ( $P = .17$ ), age ( $P = .25$ ), marital status ( $P = .41$ ), diseases/disorders ( $P = .17$ ), and cognitive dysfunction ( $P = .74$ ). However, elderly people who lived in assisted-living residences more frequently had missing values on the IM-E-SA as compared with those who lived independently or in a home for the elderly or nursing home ( $P < .001$ ). The included older adults had an average age of 81 years and 64% of the participants were female (see Table 1). They had an IM-E-SA median score of 14 (interquartile range 10–18), which is lower than the IM-E score assessed by the research nurses; 16 (interquartile range 12–21;  $P < .001$ ). After the inclusion of 90 elderly persons, assessments of ADL (Katz extended), quality of life (EQ-5D) and mental health (SF-36 mental health subscale) were added to the home interview. These measures were filled out by the majority of the elderly persons ( $n = 248$ ). Persons who completed all measures lived statistically significantly more often in assisted living residences or homes for the elderly/nursing homes ( $P < .001$ ) and statistically more often had diseases/disorders ( $P < .001$ ) compared to those who did not complete the additional measures.

### Feasibility

The average number of missing values per participant was .3 and the percentages of missing values per item of the IM-E-SA ranged from 0 to 5%. During the semi-structured interview 18% of the included elderly persons ( $n = 61$ ) questioned the clarity of some of the IM-E-SA items. The majority of these elderly persons ( $n = 40$ ) gave feedback on the prognosis items, indicating that they were living by the day and did not think about possible changes in the future.

### Reliability

In this population the homogeneity as reflected by Cronbach's alpha was .78. The interrater reliability between the IM-E-SA and IM-E total scores as assessed by the ICC was .68 (95% CI .54–.77). The interrater reliabilities for the IM-E-SA domains were as follows: biological .62 (95% CI .53–.69); psychological .59 (95% CI .48–.63); social .50 (95% CI .20–.73); and health care .50 (95% CI .42–.58).

### Construct validity

Table 2 shows the statistical differences on the median total IM-E-SA scores between elderly subgroups based on demographic and diseases/disorders characteristics (known-group validity). The IM-E-SA discriminated between elderly subgroups since, in comparison with home-dwelling older adults, statistically significant higher levels of case complexity were found among older people who lived in assisted-living residences, homes for the elderly or nursing homes. Also, participants with two or more diseases/disorders had significant higher IM-E-SA scores compared with participants with less than two diseases/disorders. The correlations between the IM-E-SA total score and comparable constructs ranged from

**Table 1**

Baseline characteristics of the included elderly population ( $n = 338$ ).

Sex (n, %)	
Female	216 (64)
Age (mean, SD)	81 (8)
Marital status (partner/spouse) (n, %)	115 (34)
Living situation (n, %)	
Home-dwelling elderly	164 (49)
Assisted-living residences	59 (17)
Living in home for the elderly or nursing homes	115 (34)
Diseases <sup>a</sup> (n, %)	
Degenerative joint disease	181 (54)
Cardiovascular disease	152 (45)
Diabetes mellitus	69 (20)
Pulmonary disease	64 (19)
Stroke	51 (15)
Subjective cognitive dysfunction (n, %) <sup>c</sup>	
No cognitive dysfunction	298 (88)
Some cognitive dysfunction	40 (12)
Assessments case complexity	
Case complexity client version (IM-E-SA)	
Median (IQR <sup>b</sup> )	14 (10–18)
Proportions case complexity (IM-E-SA $\geq 21$ )	13%
Case complexity professional version (IM-E)	
Median (IQR <sup>b</sup> )	16 (12–21)
Proportions case complexity (IM-E $\geq 21$ )	20%
Additional assessments (median, IQR <sup>b</sup> )	
Frailty (GFI)	4 (2–7)
Life satisfaction (Cantril's Ladder of Life)	7 (6–8)
Quality of life (EQ-5D) <sup>d</sup>	.8 (.5–1.0)
ADL (Katz extended) <sup>d</sup>	5 (3–7)
Mental Health (SF-36) <sup>d</sup>	72 (60–88)

<sup>a</sup> The selected diseases showed the highest prevalence in the population.

<sup>b</sup> Interquartile range.

<sup>c</sup> Subjective cognitive dysfunction was assessed with the cognitive item of the Groningen Frailty Indicator.

<sup>d</sup>  $n = 248$ .

.50 to .70 (convergent validity, see Table 3). Correlations calculated to measure different constructs ranged from .38 to .53 (discriminant validity).

### Post-hoc analyses

The post-hoc analyses, repeating the analyses in different subgroups and using different cut-offs for the number of missing values allowed on the IM-E-SA, did not alter the results. However, in the elderly subgroup with mild cognitive dysfunction the reliability of the IM-E-SA was lower: the Cronbach's alpha was .67 and the ICCs ranged from .30 to .54. Post-hoc univariate and multivariate regression analyses were performed to assess which demographic and clinical variables were statistically significant associated with the difference between the IM-E-SA and IM-E total scores. Univariate linear regression analyses showed that having more diseases/disorders ( $\beta$  .38 [95%CI, .00–.75]), a higher frailty score ( $\beta$  .35, [95%CI .16 to .55]) and lower life

**Table 2**

Median scores of case complexity in elderly subgroups assessed with the IM-E-SA.

	IM-E-SA Median (IQR <sup>a</sup> )
Gender	
Female ( $n = 122$ )	13 (10–18)
Male ( $n = 216$ )	14 (9–18)
Age	
65–82 years ( $n = 173$ )	13 (8–19)
$\geq 83$ years ( $n = 165$ )	14 (10–18)
Marital status	
Widow/single ( $n = 223$ )	14 (10–19)
Spouse/partner ( $n = 115$ )	13 (8–17)
Living situation <sup>b</sup>	
Home-dwelling elderly ( $n = 164$ )	12 (7–18)
Assisted-living residences ( $n = 59$ )	15 (10–18)
Living institutionalised ( $n = 115$ )	15 (11–19)
Diseases and disorders	
0–1 disease/disorder ( $n = 104$ )	8 (4–13)
2 diseases/disorders ( $n = 94$ )	13 (11–18)
$\geq 3$ diseases/disorders ( $n = 140$ )	17 (13–21)

<sup>a</sup> Interquartile range.

<sup>b</sup> Kruskal–Wallis test:  $P \leq .05$ .



**Table 3**

Convergent validity and discriminant validity of the IM-E-SA total score and IM-E-SA domains, with IM-E total score, IM-E domains, GFI, SF-36, Diseases and disorders, EQ-5D, Cantril's Ladder of Life, and Katz extended.

	Total IM-E-SA	IM-E-SA domain biological	IM-E-SA domain psychological	IM-E-SA domain Social	IM-E-SA domain health care
	R <sup>a</sup>	R	R	R	R
Convergent validity					
Case complexity (IM-E) <sup>b</sup>	.70	– <sup>c</sup>	–	–	–
IM-E domain biological	–	.60	–	–	–
IM-E domain psychological	–	–	.55	–	–
IM-E domain social	–	–	–	.63	–
IM-E domain health care	–	–	–	–	.50
Frailty (GFI)	.69	–	–	–	–
Mental health (SF-36)	–	–	.57	–	–
Diseases and disorders	–	.51	–	–	–
Discriminant validity					
Quality of life (EQ-5D)	.41	–	–	–	–
Life satisfaction (Cantril's Ladder of Life)	.53	–	–	–	–
Activities of daily living (Katz extended)	.38	–	–	–	–

<sup>a</sup> All calculated Spearman rank correlations are in absolute values.

<sup>b</sup> Correlations between the IM-E with the GFI, EQ-5D, Cantril's Ladder of Life and Katz extended were respectively: .57, .40, .44, and .38.

<sup>c</sup> No correlations calculated.

satisfaction ( $\beta = .58$  [95%CI  $-.95$  to  $-.20$ ]) were associated with an increased difference between the total scores of the IM-E-SA and IM-E. Afterwards, a multivariate linear model was tested by including diseases/disorders, frailty and life satisfaction as independent variables in the model. Only frailty remained statistically significant in the model (adjusted  $\beta$  .36 [95%CI .13 to .60]).

## Discussion

The objective of this study was to perform a psychometric evaluation of the IM-E-SA. The results of this study support the feasibility, reliability and validity of the self-assessment version of the IM for the elderly in home-dwelling and institutionalised elderly people.

The feasibility of the IM-E-SA was good; the percentages of missing values per item ranged from 0 to 5%. The prognosis items of the IM-E-SA had the highest percentages of missing values. During the home interview the elderly participants indicated that these items were difficult to complete since they were living by the day and did not think about possible changes in the future. Therefore we suggest to add the following answer category to the prognosis items 'I live by the day and I do not think about possible changes in the future', with a corresponding anchor scoring point of '1'. This anchor point for scoring indicates some healthcare needs as it implies that an elderly may not easily cope with changes in their future life. Additionally, by living by the day no possible future problems will be discussed with a healthcare professional and as a consequence the older adult may be less willing to use preventive interventions. Elderly people living in assisted-living residences had more missing values than older adults living independently or in a nursing home. Possibly the first group had more problems with completing the items than the home-dwelling participants. Additionally, in comparison with nursing home residents, older adults living in assisted-living residence might have received less assistance from relatives or health care staff to record their own opinion about their case complexity.

The internal consistency of the IM-E-SA was good; the calculated Cronbach's alpha was .78 which corresponds to previous findings on the good internal consistency of the IM-E [12] and original IM [6,11]. The interrater reliability between the IM-E-SA and IM-E calculated with ICCs indicated a substantial to moderate agreement for the total score and the domain scores of both measures. These findings are somewhat lower as compared with the findings of Wild et al., who reported almost perfect interrater agreement of determining case complexity using the IM-E [12]. Lobo et al. found also almost perfect agreement for the assessment of case complexity with the original IM [28]. However, both studies were performed in clinical settings and the involved raters were trained health care professionals who

assessed comparable instruments. In our study we used two different instruments: one to be assessed by professionals and the other to be completed by the elderly persons themselves, who include in their assessments not only their medical condition, but also their mental condition, preferences and family circumstances. This explains why the ICCs were not as high as would have been expected when the same participants had completed the measure at two times (intra rater reliability). But this study procedure also shows that, in contrast with professionals, older adults evaluated their situation as less case complex and therefore tend to minimize their problems. This is also reflected by the results of the post-hoc analyses that showed that the discrepancy between case complexity as assessed by professionals versus the older people themselves is higher in frail participants than in non-frail elderly people.

With regard to construct validity, the results of the known-group validity analyses showed that overall the IM-E-SA discriminated between elderly subgroups. The results also showed evidence for both its convergent and its discriminant validity. As expected, we found moderate to strong correlations between the IM-E-SA, including its different domains, and rather similar constructs, like case complexity as assessed by the total and domain scores of the IM-E. Also frailty, as a multidimensional construct, correlated substantially with the total score of the IM-E-SA. The correlations between the IM-E-SA and measures of other constructs were lower and appeared moderate. The correlation between life satisfaction and IM-E-SA was even higher than expected. This may be due to the fact that a part of life satisfaction is at least partially caused by healthcare needs as measured with the separate IM-E-SA domains.

We maintain the value of the instrument despite some limitations of the present study. Firstly, the psychometric evaluation of the IM-E-SA was only tested in the Dutch language and the Dutch health care system. In future studies it should be evaluated in other languages and countries as well. Secondly, the cut-off score of the IM-E-SA used to detect elderly persons with complex care needs was set at 20/21 [11,18]. In general, all elderly subgroups indicated themselves less case complex than the research nurses did. A cut-off score can be important for clinical decision-making and in clinical studies. However, in population based studies the total score of the IM-E-SA variables can be used to segment persons into useful categories to organise different care pathways. Elderly persons with low scores on the IM-E-SA will be candidates for standard care, while for those with high scores an individually tailored care trajectory should be designed. Future longitudinal studies should assess optimal cut-off points of the IM-E-SA. Possibly, optimal cut-off values vary according to study populations and poor outcomes evaluated. Previous results in clinical settings showed that the original IM can predict

negative outcomes [18,29]. Probably the IM-E-SA has similar discrimination features, but these have to be confirmed in a longitudinal study. The final limitation was related to the data collection. During the study the Katz, SF-36 and EQ-5D were added to the interview and therefore these instruments were not completed by all included elderly persons. However, post-hoc analyses showed consistent results of the psychometric evaluation of the IM-E-SA of the participants who completed all measures and those who omitted some items.

Major strengths of the study are the extensive psychometric evaluation of the IM-E-SA in a heterogeneous elderly population, thus supporting the generalisability of the results. However, due to poor cognition or poor health, some older people may experience problems with filling out the IM-E-SA. For these elderly persons case complexity should be assessed with the IM-E. In addition, post-hoc analyses in the subgroup of elderly adults with mild cognitive dysfunction showed less positive results on reliability. But less consistent answers are what we would expect from this subgroup of participants. However, the results of the post-hoc analyses should be interpreted with caution due to the small sample size of this subgroup. Our results show that the IM-E-SA can be used in clinical practice and research. Health care providers in inpatient and outpatient clinics can use the IM-E-SA to identify elderly persons with complex care needs and to select those who are in need for interdisciplinary care. Preferably, this process should be managed and coordinated by a single healthcare professional to whom the elderly persons can address their care needs and responsibilities for dealing with them. To facilitate inter-professional communication, the IM-E-SA items were organised on a grid and the acuity is visualized with colours [12,30]. A score of zero corresponds with the colour green and indicates no further adaptations in care taking were necessary. As a score of three indicates the colour red, this indicates immediately caretaking [12]. Additionally, the coloured scoring of the IM-E-SA may aid to establish an individually tailored care plan. In the general population and also in epidemiological settings the IM-E-SA can be used to report the level of case complexity.

We conclude that the results of this study support the feasibility, reliability and validity of the self-assessment version of the IM-E in a heterogeneous elderly population.

### Conflict of interest

The authors have no financial support, or other relationships that might lead to a conflict of interest.

### Author contributions

The authors contributed to the manuscript as follows: H. Boter, J.P.J. Slaets and E. Buskens designed the study; L.L. Peters performed the statistical analyses and wrote the successive drafts of the paper; H. Boter, J.P.J. Slaets and E. Buskens supervised and commented on all drafts. The final manuscript was approved by all authors.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.jpsychores.2013.02.003>.

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